## Solving System of Equations Algebraically

Complete the following questions. When you finish there should not be blue highlighted text as you will remove it to answer the questions.

**Common Core State Standards**

**MCC9‐12.A.REI.5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

**MCC9‐12.A.REI.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Part 1:

You are given the following system of two equations: *x* + 2*y* = 16

3*x* – 4*y* = –2

1. What are some ways to prove that the ordered pair (6, 5) is a solution?

Did you answer the question in a complete sentence? Yes or No

* 1. Prove that (6, 5) is a solution to the system by graphing the system using Geogebra or Geometry Sketchpad. Paste your graph here.
  2. Prove that (6, 5) is a solution to the system by substituting in for both equations.

Show your work here.

1. Multiply both sides of the equation ***x* + 2*y* = 16** by the constant ‘7’. Show your work.

**7**\*(*x* + 2*y*) = **7**\*16

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ New Equation

* 1. Does the new equation still have a solution of (6, 5)? Justify your answer.

Did you answer the question in a complete sentence? Yes or No

* 1. Why do you think the solution to the equation never changed when you multiplied by the ‘7’?

Did it have to be a ‘7’ that we multiplied by in order for (6, 5) to be a solution? Did you answer the question in a complete sentence? Yes or No

* 1. Multiply ***x* + 2*y* = 16** by three other numbers and see if (6, 5) is still a solution.
     1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Did it have to be the first equation ***x* + 2*y* = 16** that we multiplied by the constant for (6, 5) to be a solution? Did you answer the question in a complete sentence? Yes or No

Multiply **3*x* – 4*y* =** –**2** by ‘7’? Is (6, 5) still a solution? Did you answer the question in a complete sentence? Yes or No

* 1. Multiply **3*x* – 4*y* =** –**2** by three other number and see if (6, 5) is still a solution.
     1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Did you answer the question in a complete sentence? Yes or No

1. Summarize your findings from this activity so far. Consider the following questions: What is the solution to a system of equations and how can you prove it is the solution?

Does the solution change when you multiply one of the equations by a constant?

Does the value of the constant you multiply by matter?

Does it matter which equation you multiply by the constant?

Did you answer the question in complete sentences? Yes or No

Let’s explore further with a new system. 5*x* + 6*y* = 9

4*x* + 3*y* = 0

1. Show by substituting in the values that (-3, 4) is the solution to the system. Show work here.
2. Multiply **4*x* + 3*y* = 0** by ‘-5’. Then add your answer to **5*x* + 6*y* = 9**. Show your work below.

(–5)\*(4*x* + 3*y*) = (–5)\*0 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Answer

+ 5*x* + 6*y* = 9\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ New Equation

1. Is (–3, 4) still a solution to the new equation? Justify your answer. Did you answer the question in a complete sentence? Yes or No
2. Now multiply 4*x* + 3*y* = 0 by ‘–2’. Then add your answer to **5*x* + 6*y* = 9**. Show your work below.

What happened to the *y* variable in the new equation? Did you answer the question in a complete sentence? Yes or No

* 1. Can you solve the new equation for *x*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. What is the value of *x*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. Does this answer agree with the original solution? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  4. How could you use the value of *x* to find the value of *y* from one of the original equations? Show your work below.

The method you have just used is called the Elimination Method for solving a system of equations. When using the Elimination Method, one of the original variables is eliminated from the system by adding the two equations together. Use the Elimination Method to solve the following system of equations:

1. –3*x* + 2*y* = -6 10. –5*x* + 7*y* = 11

5*x* – 2*y* = 18 5*x* + 3*y* = 19

Solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Show work here!

**Solving System of Equations Algebraically**

Part 2:

When using the Elimination Method, one of the original variables is eliminated from the system by adding the two equations together. Sometimes it is necessary to multiply one or both of the original equations by a constant. The equations are then added together and one of the variables is eliminated. Use the Elimination Method to solve the following system of equations:

1. 4*x* + 3*y* = 14 (Equation 1)

–2*x* + *y* = 8 (Equation 2)

Choose the variable you want to eliminate. Your choice \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. To make the choice, look at the coefficients of the *x* terms and the *y* terms. The coefficients of *x* are ‘4’ and ‘–2’. If you want to eliminate the *x* variable, you should multiply Equation 2 by what constant? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     1. Multiply Equation 2 by this constant. Then add your answer equation to Equation 1. What happened to the *x* variable?
     2. Solve the equation for *y*. What value did you get for *y*?
     3. Now substitute this value for *y* in Equation 1 and solve for *x*. What is your ordered pair solution for the system?
     4. Substitute your solution into Equation 1 and Equation 2 to verify that it is the solution for the system.

Show your work here.

* 1. The coefficients of *y* are ‘3’ and ‘1’. If you want to eliminate the *y* term, you should multiply Equation 2 by what constant? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     1. Multiply Equation 2 by this constant. Then add your answer equation to Equation 1. What happened to the *y* variable? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Show work here.

* + 1. Solve the equation for *x*. What value did you get for *x*?

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* + 1. Now substitute this value for *x* in Equation 1 and solve for *y*. What is your ordered pair solution for the system? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Use your findings to answer the following in sentence form:

* 1. Is the ordered pair solution the same for either variable that is eliminated? Justify your answer. Did you answer the question and justify your answer?
  2. Would you need to eliminate both variables to solve the problem? Justify your answer. Did you answer the question and justify your answer?
  3. What are some things you should consider when deciding which variable to eliminate? Did you answer the question and justify your answer?

Is there a wrong variable to eliminate? Did you answer the question and justify your answer?

* 1. How do you decide what constant to multiply by in order to make the chosen variable eliminate? Did you answer the question and justify your answer?

Use the elimination method to solve the following systems of equations. Verify your solution by substituting it into the original system.

1. 3*x* + 2*y* = 6 3. –6*x* + 5*y* = 4 4. 5*x* + 6*y* = -16

–6*x* – 3*y* = -6 7*x* – 10*y* = –8 2*x* + 10*y* = 5

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Show work here!